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Eliciting discount rates in military personnel

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THESIS

ELICITING DISCOUNT RATES IN MILITARY PERSONNEL

by

Clarence D. Washington, Jr.

December 2012

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13. ABSTRACT (maximum 200 words)

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The CNA study modeled the value of the current military retirement system and alternative retirement systems to service members utilizing a net present value (NPV) measurement. The proposed alternatives attempt to offer cost savings to the Department of the Navy (DoN) while maintaining an equivalent NPV to the service member in order to mitigate retention and force structure risk associated with a change in retirement systems.

A significant factor in calculating NPV is the discount rate that service members apply towards various types of compensation. Current models have utilized static discount rates which do not account for the observed changes in discount rates individuals apply towards items based on when they expect to receive those items and other biasing factors.

This thesis develops a method to measure military service members discounting behaviors across different spans of time. This thesis evaluates the impact that time inconsistent discount rates might have on the NPV of retirement alternatives calculated in the draft CNA report on Navy retirement reform.

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ELICITING DISCOUNT RATES IN MILITARY PERSONNEL

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LIST OF ACRONYMS AND ABBREVIATIONS

CBO	Congressional Budget Office
CD	Certificate of Deposit
CNA	Center for Naval Analyses
CP	Continuation Pay
CTB	Convex Time Budget
DB1	Defined Benefits 1
DB2	Defined Benefits 2
DC	Defined Contribution
DoD	Department of Defense
DON	Department of the Navy
DU	Discounted Utility
GDP	Gross Domestic Product
IDR	Individual Discount Rate
OSD	Office of the Secretary of Defense
VCNO	Vice Chief of Naval Operations
MPL	Multiple Price List
NPS	Naval Postgraduate School
NPV	Net Present Value
SIPRI	Stockholm International Peace Research Institute
TP	Transition Pay (TP)
YOS	Years of Service

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I. INTRODUCTION

A. BACKGROUND

Recent U.S. federal deficit spending and a growing U.S. national debt have become increasingly popular topics for political debate, leading to calls for reforms and reductions in federal government spending. The Congressional Budget Office (CBO) estimates put federal deficit spending at $1.2 trillion for 2012, with total federal debt increasing to 73 percent of gross domestic product (GDP) (CBO, 2012b). This is its highest level since the 1950s and nearly twice the debt to GDP ratio in 2007 (CBO, 2012b). As a major recipient of federal funds, the Department of Defense (DoD) believes that it may soon be forced to reduce its budgets to comply with federal spending reductions, should they occur (Grefer, Phillips, & Shufford, 2012). Additionally, DoD believes that current personnel costs are both too high and growing at unsustainable rates (Grefer et al., 2012). As political and policy dialogue on federal spending continue, what is certain is that military retirement will continue to be analyzed and debated because congressional law requires the President to provide a comprehensive evaluation and recommendations on military retirement every four years (U.S.C., Title 37, Section 1008b).

As a means to reduce federal spending tied to the military, DoD is investigating reforms to the current military retirement system. The Vice Chief of Naval Operations (VCNO), in response to Office of the Secretary of Defense's (OSD) interest in retirement reform, tasked the Center for Naval Analyses (CNA) to conduct a study of military retirement reform proposals developed by OSD. Specifically, the Department of the Navy (DON) expressed interest in how proposed changes to military retirement would impact Navy costs and personnel (Grefer et al., 2012). It should be noted that the CNA report is categorized as a preliminary report and is thus subject to further review and analysis prior to release and/or DON endorsement (Grefer et al., 2012). This report is referred to as the "CNA study" or "CNA report" throughout this document.

In conjunction with the CNA study, the Naval Postgraduate School (NPS) was also called upon to conduct research and analysis on military retirement reform for DON at the request of the VCNO. This thesis and its accompanying research were designed to provide additional analysis and insight into potential reforms to the current military retirement system. Specifically, this thesis reviews methodologies and results of past scientific studies that measure individual discount rates (IDR) with the objective of designing an IDR experiment and surveying methodology that can be deployed within DoD to better measure service member IDRs and thus better estimate service members' responses to changes in retirement and other compensation.

B. PURPOSE OF THE STUDY

The objective of this research is to determine what type of IDR methodology will most accurately predict the discounting behavior of military personnel when faced with significant changes to retirement or other compensation. We are hopeful that this research can help policymakers build more accurate models, which may be utilized to predict military members' responses to potential alternations of the military retirement system. By reviewing prior research on individual discount rates, we are able to develop an optimized approach to eliciting discount rates in military personnel.

C. RESEARCH QUESTIONS

The perceived value of military pay and compensation, including the military retirement benefit, has substantial influence on who joins the military and how long they remain. Because of this relationship, changes to military compensation must be carefully implemented to safeguard national defense capabilities from unexpected and unintended shifts in retention and/or recruiting. This thesis addresses two primary research questions. First, what is an optimal methodology to measure IDRs in service members? Because discount rates significantly impact net present value (NPV) calculations which are utilized to evaluate alternative retirement options, it is critical for policymakers to

utilize accurate IDRs that produce realistic NPVs. Secondly, *a priori*, how do demographic factors correlate to IDRs, and what potential implications do they present for DoD?

D. SCOPE AND METHODOLOGY

This thesis analyzes the findings of past research to develop an optimal method for eliciting personal discount rates in military personnel. The experiment is designed to utilize a population sample of active-duty military personnel, consisting of both enlisted personnel and officers, across the spectrum of experience and time in service. We believe that experience and time in service could have significant impacts on IDRs, thus it is important for the experiment to encompass a diverse field of military personnel. Experimental design limits the population to active-duty military personnel, due to the significant differences in retirement compensation between active and reserve military personnel. This research is primarily limited to finding the aggregate perspective of military personnel based on the likelihood that any changes to military retirement would affect the aggregate; however, the experimental design we adopt does allow for analysis at the individual level (Andreoni & Sprenger, 2012). The research design we have chosen, based primarily on the recent work of Andreoni and Sprenger, addresses both convex and discrete budget sets. Andreoni and Sprenger (2012) limit their design to short run intertemporal choice whereas we plan to expand the experimental design to include long-run decisions.

We have developed a two-by-two experimental design utilizing both convex and discrete approaches to measuring discount rates, across both relatively short and long periods of time. The convex methodology is based on the convex time budget (CTB) approach developed by Andreoni and Sprenger (2012). With CTB, individuals are provided a budget of tokens, which they may allocate to a near-term or a more distant time period. Tokens redeemed at the near term typically have a lower value than if they were redeemed at the later period. The discrete methodology utilizes a multiple price list (MPL) approach, which is employed in numerous prior studies (Harrison, Lau, & Williams, 2002; Thaler, 1981). With MPL, individuals are asked to choose between

receiving a benefit *x* at a near time period or a benefit of *x* + (some additional amount) at a later time period. These questions are asked multiple times in a list format, with alterations to the additional value or the time period between benefits. Both methods utilize monetary payments and are deployed in a laboratory environment. Experimental design is explained in detail in Chapter IV.

E. ORGANIZATION OF THE RESEARCH

This thesis is organized as follows. Chapter II reviews the history of military retirement and current interest in military retirement reform. Chapter III provides a literature review of time preference research, with a focus on MPL and CTB oriented studies. Chapter IV describes an optimal experimental design for eliciting discount rates in military personnel, based on the findings of our research. Chapter V provides a brief review of the discount rate methodology used in the recent CNA analysis of military retirement. Chapter VI provides findings of the research and recommendations.

II. HISTORY OF MILITARY RETIREMENT AND REVIEW OF PROPOSED MILITARY RETIREMENT REFORM

A. A BRIEF HISTORY OF MILITARY RETIREMENT

Calls for reform to the military retirement system are not new. The military retirement system has been polarizing since its inception in the late 1940s, drawing sharp criticism as well as strong support. In general, the system has received strong support from military members, Congress, and defense manpower analysts, while the general public has regularly found issue with the potentially young age of retirees and the cost associated with the benefits those retirees receive (Hudson & Buchalter, 2007). Despite numerous calls for a complete overhaul of the retirement system, only moderate adjustments to the formula used to calculate retirement pay have occurred, leaving military retirement largely unchanged since its modern inception in 1947 (Henning, 2008). At present, the two most salient features of military retirement remain unchanged: a defined benefit lifetime annuity and a requirement for 20 years of service (YOS) to vest and receive said annuity.

The 20 YOS vesting cliff for officers was first implemented in 1946 for the Navy and Marine Corps, and in 1948 for the Army and the then newly established Air Force (Christian, 2006). Prior to this adjustment, Navy and Marine Corps officers had a 30 YOS vesting while the Army had a 15 YOS vesting cliff. Enlisted personnel of all services were not eligible for voluntary retirement until 1945, when legislation provided them with a 20 YOS vesting cliff and benefits in alignment with the officer community. Christian (2006) cites military member welfare and private-sector competitiveness as major reasons for eventually including enlisted personnel.

Another major feature of the military retirement system is the method by which retirement pay is calculated. Features of the current system can be traced back to Navy officer retirement pay legislation first implemented in 1855, in which separated officers were provided 75 percent of sea duty pay (Christian, 2006). The most direct lineage can be seen in the military “up or out” promotion system of 1915, which created retirement

pay of 2.5 percent times YOS, up to a maximum of 75 percent of pay (Christian, 2006). The 1915 framework remains basically unchanged today.

The major adjustment between the "up or out' system of 1915 and the present system is the calculation of final pay. As a result of past adjustments to the way in which final pay is calculated, the military retirement system currently utilizes three different retirement pay formulas to determine benefits for retired active duty personnel, and two formulas to calculate benefits for retired reservists (Henning, 2008). Qualification for the different formulas is based on the date of entry for service members. The most recent pay formula system is referred to as the "High-Three System," based on a retirement benefits pay calculation that takes the average of the highest three years of basic pay a service member has earned. An alteration of this system is referred to as "REDUX," which provides a $30,000 bonus during service years in exchange for reduced retirement benefits. The prior systems, which still retains a limited number of beneficiaries, is referred to as the Final Basic Pay System, due to its retirement benefits pay calculation that utilizes the final basic pay a service member received. As retirement programs have been adjusted and scaled back, members who joined prior to the adjustments have historically been grandfathered into the pay formula in place when they entered the military. Current reform efforts have focused on changes to both active and reserve duty retirement pay (Henning, 2008); however, this study focuses on the active duty retirement system and on potential changes to the most recent retirement compensation formula.

B. RENEWED INTEREST IN RETIREMENT REFORM

A growing national debt and increased deficit spending by the federal government within the context of a struggling U.S. economy have increased scrutiny of the military retirement system (Grefer et al., 2012). In 2011, $699 billion of the $1.3 trillion in discretionary federal spending was allocated to military programs (CBO, 2011a). U.S. military spending ranks first globally at 41 percent of total military spending, with China number two at roughly eight percent followed by Russia at four percent (Stockholm International Peace Research Institute [SIPRI], 2012). Critics of military retirement cite retirement program cost growth, retirement trust fund unfunded liability growth, and

retirement benefits that are considered more generous than the private sector (Henning, 2008). DoD's Office of the Actuary projects military retirement costs of $51.7 billion in 2012 with projections that those costs will rise to $59.0 billion by 2022 (DoD, 2010). Christian (2006, p. ix) provides greater granularity, listing these five major driving forces behind recent efforts to reform military retirement compensation:

- Cost: Reducing the benefits associated with the transition from active duty to civilian life during the so-called "second-career phase" of military retirement. (The term "second- career phase" refers to the fact that service members who are fully vested receive an immediate annuity upon retirement, which is often at a young enough age for them to embark on a second career until they reach old-age retirement.)
- Equity: Providing benefits for members separating before 20 years of service (YOS) as well as for those who are vested at 20 YOS.
- Selective retention: Increasing incentives for key service members to stay beyond 20 YOS.
- Civilian comparability: Providing a defined contribution plan that vests earlier than 20 YOS. (The military retirement system is a defined benefit plan, commonly called a pension plan in the private sector. The Thrift Savings Plan is a type of defined contribution plan.)
- Force management flexibility: Providing tools for the services to create variable careers for the services to create variable career lengths when needed for force management. (Christian, 2006, p. ix)

Asch, Johnson, and Warner (1998) provide numerous criticisms of the current retirement system that are also noted in the later works of Grefer et al., (2012), Henning (2008), and Christian (2006). Asch et al., (1998) note a lack of equity, referencing the fact that outside of disability, there are no retirement benefits for military members who fail to complete 20 YOS. Additionally, they note that the current system is poorly structured for flexible force management and carries excessively high costs compared to benefits found in the private sector. In contrast, military manpower planners often praise the current military retirement system due to the retention stability it creates and the importance of this stability in providing a high quality volunteer force capable of meeting the Americas' war fighting requirements (Hudson & Buchalter, 2007).

The all-or-nothing 20 YOS vesting cliff is commonly seen as unfair, especially in the context of a decade long war in which most of America's warfighters will not receive

a retirement benefit. However, Myung (unpublished survey, 2012) surveying 350 service members comprised primarily of commissioned officers from NPS and Second Marine Expeditionary Force (II MEF) found that 69.8 percent of respondents felt the current military retirement system is fair, when provided figures showing that only 17 percent of active duty military members will serve long enough to receive retirement. Hudson and Buchalter (2007) find that approximately 30 to 40 percent of military officers will complete 20 YOS and reach retirement benefits eligibility and only 10 to 15 percent of enlisted personnel will reach 20 YOS. The generally low percentages and significant disparity between officers and enlisted personnel highlight the equity issue.

Despite these criticisms, it remains extremely difficult and divisive for policymakers to determine what constitutes an appropriate compensation for America's retired military. Most criticisms focus on the issue of civilian comparability. This approach might achieve greater validity if comparisons to military compensation were limited to private-sector jobs that entail similar unpaid overtime requirements and occupational hazards. Law enforcement and firefighting would likely present similar occupational hazards; however, those professions are largely unionized so adjustments for overtime compensation would need to be taken into consideration. Henning (2008) notes that some consider the military retirement system to be fair given the hardships endured by service members who have deployed numerous times to Iraq and Afghanistan.

Ultimately, policymakers are left to make tough choices that balance the cost of the military retirement system with the future defense needs of the country and provide equity for members of the military. Significant changes to military retirement could have negative impacts on recruiting and retention and would likely entail changes to force structure and military readiness Christian (2006). Although difficult to achieve, it is possible that policymakers will be able to create an alternative retirement system that creates equal or greater welfare, at a lower cost to the government, by changing the timeline in which benefits are received. To the contrary, continued inaction would dangerously ignore known issues with a program displaying excessive cost growth.

III. LITERATURE REVIEW OF PREVIOUS TIME PREFERENCE RESEARCH

A. INDIVIDUAL DISCOUNTING RATES AND THE DISCOUNTED UTILITY MODEL

Personal discount rates-how individuals value current versus future benefits-are an important tool for economists and public policymakers. However, because of their very subjective nature, the task of measuring and correctly applying discount rates in economic models has long been scrutinized and remains contentious. The difficulty reflects the fact that personal discount rates require blending mathematical theory and human behavior. As a sign of this confluence, research on time preferences is commonly carried out in both the field of economics as well as psychology (Frederick, Shane, Loewenstein, &O'Donoghue, 2002). While one individual may prefer a steady stream of income because of the consumption smoothing stability it provides, another individual who places less value on stability may prefer large chunks of income coupled with periods of instability, demonstrating a more prominent preference towards present bias. The difficulty for policymakers is to determine where the middle ground lies, thus providing all parties with an adequate level of benefit, while reducing the hardship incurred by individuals who are receiving benefits at other than the individual optimum levels.

The foundation of personal discount rate theory can be largely attributed to the work of American Economists and Nobel Prize winner Paul Samuelson in his 1938 discounted utility (DU) framework (Goldin, 2007). Samuelson encapsulated the idea of intertemporal choice into a mathematical equation where all variance in choice could be explained by a single variable, the discount rate. Samuelson argued that costs and benefits occurring at various times can be easily compared by applying a discount rate (Ainslie, 2007), and thus normalizing the measurements. Mathematically, Samuelson's theory is represented as follows:

$$U(x_0, x_1, x_2, ...) = \sum_{t=0}^{\infty} \delta^t u(x_t)$$

U(x_0, x_1,x_2,…) represents the total utility of all options of x. $u(x)$ represents the instantaneous utility of each individual x at any time t. δ represents the discount factor where $\delta = (1/1+d)$ and d is the discount rate. Lastly, x represents the outcome of option x_t at some time t. Most notable from the equation is the idea that with any positive discount rate, a numerical value of benefits received today will be worth more than receiving that same numerical value in the future.

Since its introduction, Samuelson's DU model has seen widespread adoption and has served in a foundational position for many economists and social scientists (Goldin, 2007). Samuelson's work was initially adopted by researchers as having both normative and descriptive validity. Despite Samuelson's own significant reservations on the descriptive validity of his model (Frederick et al., 2002), the simplicity and intuitive nature of his DU model saw rapid adoption and utilization in the field of intertemporal choice.

B. LIMITATIONS OF THE DISCOUNTED UTILITY MODEL

More recently, researchers have acknowledged the limitations of the DU model, noting shortcomings with the primary assumption of the DU model, the concept that "all of the disparate motives underlying intertemporal choice can be condensed into a single parameter-the discount rate" (Frederick et al., 2002, p. 351), which requires individuals to display time consistent preferences. As the body of research has grown, it has become apparent that the DU model lacks descriptive validity. Thaler explains that theoretically in capital markets individuals and firms should behave "the same way at the margin since firms and individuals borrow or lend until their marginal rate of substitution between consumption today and consumption tomorrow is equal to the interest rate" (1981, p. 201). However, observations of individuals acting on their own behalf have shown the above assumption of the DU model to be invalid (Goldin, 2007; Thaler, 1981). Individuals commonly borrow from tomorrow at rates far exceeding the interest rate. One need only look at the fees payday loan centers and credit card companies are able to charge in juxtaposition to the prevailing interest rate to view this phenomenon and realize that individuals are willing to increase their current consumption at the expense of their

future. For example, Bankrate.com shows this disparity noting 14.02 percent interest rates on credit cards for November 2012, while certificate of deposit (CD) rates during the same period yielded 0.3 percent on a one year CD.

In the DU model, an individual set to receive $100 today with a 10 percent discount rate, would be equally happy to receive $105 in six months or $110 in one year. Thaler (1981) tests the assumption of linear discounting behavior through an experiment that asks participants to choose between receiving (x) dollars now or y = (x + some additional amount) at a future date. In Thaler's experiment, students were told that they had won a lottery payment, of varying amounts, that would be held in the bank. Students were given the option to take the money now or receive a greater amount of money at a later date. Thaler then asked the students what amount of extra money (y - x) would make them equally happy if they chose the option to wait and received the money at some time in the future. Thaler found that larger prizes and longer waiting periods induced dramatic decreases in the subjects' implicit discount rates. One of Thaler's most poignant observations was that interest rates and individual discount rates are commonly not equal. Coller and Williams also found a divergence between interest rates and individual discount rates, noting the "care must be taken when applying market rates as substitutes for individual discount rates" (1999, p. 123).

C. OBSERVATIONS AND MEASUREMENTS OF DISCOUNT RATES AND THE EMERGENCE OF BIAS

Warner and Pleeter's (2001) study of military downsizing in the early 1990s provides an excellent observation of personal discounting behavior in a large group of individuals faced with financial decisions involving large sums of money. Warner and Pleeter analyzed over 65,000 service members facing a choice to receive severance compensation as a lump-sum or as an annuity, and found that an overwhelming majority elected the lump-sum option, despite a greater than 17 percent discount rate to break even on the transaction when choosing the lump-sum. This situation was rare, given the large sample size and the large sums of money in play, in comparison to the majority of the

related research relying on small groups of individuals whose behaviors are measured through scientific experiments and/or surveys. The individual service members' choices are summarized in Table 1.

Table 1. Selected Examples of Break Even Discount Rates (From Warner & Pleeter, 2001)

TABLE 1—VSI AND SSB BENEFITS, SELECTED EXAMPLES

	Lump-sum amount	Annuity amount	Present value of annuity				Break-even discount rate	Percent lump sum	Percent separating
			7 percent	10 percent	20 percent	30 percent			
Officer									
O-3 with 7 YOS	$34,709	$5,785	$54,129	$46,875	$32,002	$24,430	0.175	70.7	35.5
O-3 with 9 YOS	$46,219	$7,703	$82,908	$69,497	$44,485	$33,085	0.189	52.1	47.8
O-4 with 12 YOS	$72,006	$12,001	$147,276	$118,005	$71,106	$51,904	0.196	36.2	8.0
O-4 with 15 YOS	$94,114	$15,686	$208,274	$162,645	$93,722	$67,950	0.198	29.8	6.8
Enlisted									
E-5 with 7 YOS	$16,655	$2,776	$25,973	$22,492	$15,356	$11,722	0.175	95.1	6.3
E-5 with 9 YOS	$22,283	$3,714	$39,972	$33,506	$21,447	$15,951	0.189	94.8	28.1
E-6 with 12 YOS	$35,549	$5,925	$72,710	$58,259	$35,105	$25,625	0.196	88.1	13.2
E-7 with 15 YOS	$51,216	$8,536	$113,342	$88,510	$51,003	$36,978	0.198	74.3	8.0

Along with generally high discount rates, Warner and Pleeter (2001) found significant correlation between individual discount rates and education, age, race, sex, number of dependents, ability test scores, size of payments, and if the individual was an officer or enlisted. Amongst officers, roughly 50 percent elected to take the lump-sum option compared to a 90 percent election rate amongst enlisted personnel. Surprisingly, DoD economists had initially projected a near zero percent lump-sum take rate for officers and only a 50 percent take rate for enlisted, basing those projections on conventional interest rates[1] and the difference in total present value between the lump-sum and the annuity payments (Warner & Pleeter, 2001). Warner and Pleeter's finding of a significant divergence between interest rates and individual discount rates lends credibility to Thaler's (1981) earlier findings.

[1] Warner and Pleeter note that DoD planners used a seven percent interest rate, which was the current return during that period for money market holdings.

Warner and Pleeter (2001) found discount rates ranging from zero to 30 percent, with averages of 10.4 and 35.4 percent for officers and enlisted, respectively, which were generally higher than expected when compared with prior research. Cylke, Goldberg, Hogan, and Mairs found discount rates of 15 to 18 percent when reviewing Navy reenlistment bonuses (1982, p. 14), and Black (1984) utilized survey questions to estimate average discount rates of 10.3 and 12.5 percent for officers and enlisted personnel, respectively. More recent experimental research by Andreoni and Sprenger found aggregate discount rates of 30 percent when college students were studied in a CTB experiment (2012, p. 18).

Warner and Pleeter (2001) argue that their research provides the more compelling measurement of discount rates based on two factors. First, the military downsizing program was not hypothetical, but real and involved large sums of money. For officers, the average difference in funds to be received between selecting the lump-sum payment or annuity payments was around $50,000 (Warner & Pleeter, p. 33). For enlisted personnel, this difference averaged $25,000 (Warner & Pleeter, p. 33). Secondly, most studies have targeted very homogeneous groups of people, such as college students or low-income populations. Military downsizing, in contrast, represented a diverse group of individuals ranging significantly in age, race, education, work experience, and income. Additionally, although not specifically highlighted by Warner and Pleeter, the military personnel studied represent individuals from all 50 states and with diverse geographic stationing.

The high discount rates measured by Warner and Pleeter (2001) are not beyond criticism. It's arguable that the military downsizing in the 1990s, stemming from the fall of the USSR, was largely unexpected and caught many service members by surprise. Prior to the drawdown, military members had enjoyed significant job security. It is likely that the unexpected nature of the drawdown announcement left many service members both startled and financially unprepared to transition to civilian employment. Warner and Pleeter, albeit unintentionally, provide some support to criticism of the high discount rates they present. Specifically, they find that income levels and discount rates are inversely related, thus it could be reasoned that a sudden perceived loss of future income

(being unexpectedly asked to resign from the military) could increase discount rates in affected individuals. This inverse relationship between income and discount rates is substantiated, *a priori*, by both Gilman (1976) and Black (1984).

D. NOTABLE OBSERVATIONS OF HUMAN BIAS IN DISCOUNT RATES

In their literature review, Warner and Pleeter (2001) nicely summarize three general findings from the field of time preference research, spanning from the mid-1970s through 2001. Firstly, individuals do not use a common discount rate for all future benefits, nor do they retain the same discount rate towards the same benefits at different points in time (Thaeler, 1981). Stationary instantaneous utility is a faulty assumption that contradicts these findings, but it is commonly used for analytical convenience, despite the general consensus that it is invalid (Frederick et al., 2002). A violation of stationary instantaneous utility could be as simple as considering the value of a cup of hot chocolate. An individual likely has a different value for the same cup of hot chocolate during the winter than during the summer.

Magnitude effect is another bias in which individuals do not use a common discount rate for all future benefits. An example of magnitude effect would be an individual who is set to receive $10 next week but will likely take $9 today. However, if that same individual is owed $1,000,000 next week, it is unlikely he or she would opt to receive $900,000 today, even though both decisions carry the same discount rate. Research has consistently supported the idea of magnitude effects; as the value of benefits rise, individual discount rates tend to decline (Frederick et al., 2002).

The second general finding is that discount rates vary with how near or distant the future benefit will be received. This is the concept of hyperbolic discounting, which is described by Frederick et al., (2002) as the best documented DU anomaly. Benefits to be received in the near future are commonly discounted at higher rates than benefits to be received in the distant future.

Again consider an example where an individual is due to receive $1,000,000 in one month, but can instead choose to receive $990,000 in just one week. For many people, the one week option appears to be a great deal that puts them into retirement and

on an airplane to a Hawaiian vacation in less than seven days. An alternative situation promises the same individual $1,000,000 in 20 years or the option to receive $990,000 in 19 years, eleven months and a week, just three weeks shy of 20 years. Again, the discount rates and waiting period between payoffs are exactly the same in both examples. Taking the money early in the first options seems more enticing than in the second option, supporting a pattern declining discount rates as the time to receive benefits increases. This has been confirmed in numerous studies (Benzion, Rapoport, & Yagil, 1989; Frederick et al., 2002; Thaler, 1981; Warner & Pleeter, 2001).

Andreoni and Sprenger (2010) surprisingly find no signs of hyperbolic discounting in their CTB experiment, largely in disagreement with the body of research on time preferences. They note Halevy's (2008) finding that present bias may be an artifact of individual assessments regarding the risk of receiving payments (Andreoni and Sprenger). Based on their experimental design, which places significant emphasis on reducing differential risk across the horizon of payments, Andreoni and Sprenger appear to eliminate signs of hyperbolic discounting and, at the very least, demonstrate the significant role that risk plays on time preferences.

Warner and Pleeter's (2001) third general finding is that discount rates vary significantly based on personal characteristics. Characteristics such as income, age, level of education, and race are highly correlated to discount rates. Warner and Pleeter found lower discount rates associated with higher levels of education, higher levels of income, and fewer dependents. In the case of education, discount rates in officer without a college education were found to be 7.5 percent higher than officer who held a college degree (Warner & Pleeter, 2001, p. 46). They also found correlations between race and individual discount rates, and that officers displayed lower discount rates compared to enlisted personnel (Warner & Pleeter, 2001). Coller and Williams (1999) found a correlation between discount rates and gender and, like Warner and Pleeter, also noted correlation with race. Surprisingly, Coller and Williams found a positive correlation between discount rates and wages; however, they noted this finding to be contrary to the prior research of Hausman (1979) and Lawrance (1991) and attributed their contradictory findings to their subject population of college students. Although unable to find an exact

causation, they believe it is possible “that a positive relationship between income and discount rates is an artifact of irregular income flows and expectations of future income increases that are unique to student subjects” (Coller & Williams, 1999, p. 123).

Perhaps the most significant insight into the theory of time preference and the associated body of research is provided by Frederick et al., in their exhaustive and critical review of past research. Despite numerous studies focused on determining IDRs, little consensus has been achieved by researchers. Frederick et al., (2002) propose that the variance in research results might not reflect experimental failures, but rather demonstrate that discount rates are choice specific. They use this line of reasoning to recommend that new models on intertemporal choice should incorporate more behavioral factors, thus creating more descriptively accurate models. In summary, across the body of research on intertemporal choice, there is significant variance in the discount rates that researchers have found, as evidenced in Table 2. Somewhat problematic for military retirement researchers is that much of this research deals with small sums of money and generally short periods of time. With application to military retirement reform, the most notable findings are likely that discount rates vary significantly across different intertemporal choices, based on numerous factors such as value of the benefit or time of receipt. Secondly, discount rates have strong correlations to demographic factors, providing a possibility that certain military communities or demographics might respond significantly different than the general population

Table 2. Discount Rates Across Studies (From Frederick et al., 2002)

Study	Time Range	Annual Discount Rate(s)	Annual Discount Factor(s)
Maital & Maital 1978	1 year	70%	0.59
Hausman 1979	undefined	5% to 89%	0.95 to 0.53
Gateley 1980	undefined	45% to 300%	0.69 to 0.25
Thaler 1981	3 mos. to 10 yrs.	7% to 345%	0.93 to 0.22
Ainslie & Haendel 1983	undefined	96000% to ∞	0.00
Houston 1983	1 yr. to 20 yrs.	23%	0.81
Loewenstein 1987	immediately to 10 yrs.	–6% to 212%	1.06 to 0.32
Moore and Viscusi 1988	undefined	10% to 12%	0.91 to 0.89
Benzion et al. 1989	6 mos. to 4 yrs.	9% to 60%	0.92 to 0.63
Viscusi & Moore 1989	undefined	11%	0.90
Moore & Viscusi 1990a	undefined	2%	0.98
Moore & Viscusi 1990b	undefined	1% to 14%	0.99 to 0.88
Shelley 1993	6 mos. to 4 yrs.	8% to 27%	0.93 to 0.79
Redelmeier & Heller 1993	1 day to 10 yrs.	0%	1.00
Cairns 1994	5 yrs. to 20 yrs.	14% to 25%	0.88 to 0.80
Shelley 1994	6 mos. to 2 yrs.	4% to 22%	0.96 to 0.82
Chapman & Elstein 1995	6 mos. to 12 yrs.	11% to 263%	0.90 to 0.28
Dolan & Gudex 1995	1 month to 10 yrs.	0%	1.00
Dreyfus and Viscusi 1995	undefined	11% to 17%	0.90 to 0.85
Kirby & Marakovic 1995	3 days to 29 days	3678% to ∞	0.03 to 0.00
Chapman 1996	1 yr. to 12 yrs.	negative to 300%	1.01 to 0.25
Kirby & Marakovic 1996	6 hours to 70 days	500% to 1500%	0.17 to 0.06
Pender 1996	7 mos. to 2 yrs.	26% to 69%	0.79 to 0.59
Wahlund & Gunnarson 1996	1 month to 1 yr.	18% to 158%	0.85 to 0.39
Cairns & van der Pol 1997	2 yrs. to 19 yrs.	13% to 31%	0.88 to 0.76
Green, Myerson & McFadden 1997	3 mos. to 20 yrs.	6% to 111%	0.94 to 0.47
Johanneson & Johansson 1997	6 yrs. to 57 yrs.	0% to 3%	0.97
Kirby 1997	1 day to 1 month	159% to 5747%	0.39 to 0.02
Madden et al. 1997	1 week to 25 yrs.	8% to ∞	0.93 to 0.00
Chapman & Winquist 1998	3 months	426% to 2189%	0.19 to 0.04
Holden, Shiferaw & Wik 1998	1 yr.	28% to 147%	0.78 to 0.40
Cairns & van der Pol 1999	4 yrs. to 16 yrs.	6%	0.94
Chapman, Nelson & Hier 1999	1 month to 6 mos.	13% to 19000%	0.88 to 0.01
Coller & Williams 1999	1 month to 3 mos.	15% to 25%	0.87 to 0.80
Kirby, Petry & Bickel 1999	7 days to 186 days	50% to 55700%	0.67 to 0.00
van der Pol & Cairns 1999	5 yrs. to 13 yrs.	7%	0.93
Chesson & Viscusi 2000	1 year to 25 yrs.	11%	0.90
Ganiats et al. 2000	6 mos. to 20 yrs.	negative to 116%	1.01 to 0.46
Hesketh 2000	6 mos. to 4 yrs.	4% to 36%	0.96 to 0.74
van der Pol & Cairns 2001	2 yrs. to 15 yrs.	6% to 9%	0.94 to 0.92
Warner & Pleeter 2001	immediately to 22 yrs.	0% to 71%	0 to 0.58
Harrison, Lau & Williams 2002	1 month to 37 mos.	28%	0.78

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IV. EXPERIMENTAL DESIGN: CTB AND MPL METHODOLOGY

A. INTRODUCTION

Considering the significant variability in discount rates across numerous well designed studies, we employ two separate experimental approaches to eliciting discount rates in service members. Those approaches are multiple price list (MPL) and convex time budget (CTB). MPL methodology stems from research initially conducted by Thaler (1981) that was designed partly in response to observations of unexplained time inconsistent behavior. Since Thaler, MPL has been used in several studies, most notably in the large-scale study of Denmark by Harrison et al. (2002). CTB is a newer adaptation of the MPL methodology, which addresses the discontinuity of budgets inherent in the MPL design (Andreoni & Sprenger, 2010).

Risk and transaction costs are two major issues associated with discount rates elicited in field experiments (Andreoni & Sprenger, 2010) and are thought to be partly responsible for creating hyperbolic discounting (Halevy, 2008). The subjects' risk of receiving payment and the transaction cost to the subject to claim payment are constant across both methodologies we employ, providing a rare opportunity to evaluate the outcomes of these different methodologies with equal exposure to the above biases.

Experimental design for all subjects consists of scripted instructions, MPL, CTB, or combination treatment, subject estimates of prevailing interest rates, and a survey of demographic and economics related questions. By asking subjects to provide estimates of current interest rates associated with credit cards, savings accounts, and home mortgages, we can analyze elicited discount rates against current market estimates and provide some idea of subjects financial literacy. Whereas Andreoni and Sprenger (2010) limit their study to short-term discounting behavior, this experiment seeks to gather on data on both short-term and long-term discounting behavior that could be valuable for analyzing military retirement reform options. Additionally, due to the past research of Warner and Pleeter (2001), we will be able to compare actual observed discounting

behavior with experimentally elicited behavior. A copy of instructions, experiment questions, interest rate questions, and demographic questions are provided in the appendix.

B. DEFINITIONS AND PARAMETERS

The experimental methods we utilize vary the time period in which payments are received, amount of payment subjects receive, and the growth rate of payments from earlier to later periods. Time periods are represented by time of initial payment *t*, and time between initial payment and later payment are represented by *k*. Thus, receipt of an early payment comes at time *t* and receipt of a late payment would come at $t+k$. Payment amounts are represented by initial payments of *n* which are then increased by *x* to provide later payments that have a value of $n + x$. Interest rates of *r* control the rate of growth of payments from *n* to $n+x$, such that $n * (1+r) = n+x$.

The application of payment amount boundaries and time periods is graphically displayed in Table 3.

Table 3. Experiment Design Matrix

	MPL	**CTB**
SHORT RUN	Payments (*n to n+x*): \$20–\$30 Time periods(*t to t+k*): 0–133 days Interest rates (*r*): 0–1300%	Payments (*n to n+x*): \$20–\$30 Time periods(*t to t+k*): 0–133 days Interest rates (r): 0–1300%
LONG RUN	Payments (*n to n+x*): \$67k–\$340k Time periods(*t to t+k*): 1–49 months Interest rates (*r*): 0–50%	Payments (*n to n+x*): \$67k–\$340k Time periods(*t to t+k*): 1–49 months Interest rates (*r*): 0–50%

C. MULTIPLE PRICE LIST TREATMENT

For the MPL experimental method, subjects would be asked to make choices between receiving an amount of money at some near time or receiving a larger amount

money at some later time. The basic format asks subjects if they would prefer $20 now or $20 + x at some later time. Each question contains a list of 20 options in which x begins at zero and gradually increases. As x increases, we expect individuals will begin to shift their preferences from the early payment to the later payment. The point at which an individual switches from near period consumption to the later period consumption provides an estimate of their discount rate. For example, if an individual prefers $20 near term over $25 one period later, but then switches on the next option and rejects $20 near term for $26 at the later period, we can conclude that their IDR falls between 25–30 percent.

In our experiment design, we would present this basic question to subjects in a series of six varied questions. The first four questions provide the option to receive early payment in one month, $t = 1$. We then vary the later payment periods $t + k$ at 7, 13, 25, and 49 months respectively. Time periods are selected to provide for two observations of subjects preferences for payments roughly within a one year time span, the time period in which hyperbolic discounting is most commonly observed (Frederick et al., 2002), and also provide observations of preferences at longer intervals. For the final two questions, we provide the option to receive the early payment in five years and 10 years, respectively. We then vary the later payment periods at five years and six months and also at 10 years and six months. Although our design will present subjects with three questions that have a six month waiting period, the time from present until initial payment varies significantly. This design should allow us to observe time inconsistent behavior, should it be present.

For the above design, we use two payment schemes. The first scheme uses relatively small dollar amounts where the initial payment has a value of $20 and later payments have values up to $30. These amounts are specifically selected for their close approximation to the dollar amounts used by Andreoni and Sprenger (2010) in their CTB experiment, which we replicate. Our second price scheme uses much larger numbers, where the initial payment has a value of $67,000 and later payments expand up to $340,000, the estimated NPV of military retirement for an enlisted service member as projected by Grefer et al (2012). We alter the dollar amounts between relatively

insignificant sums to relatively large sums in these two treatments to test for consistency in intertemporal preferences as the value of a benefit changes.

An additional variation is the payment description. For the six questions, individuals are told that they have been "selected to receive a cash payment." We randomly alter this description amongst subjects and instead notify them that they have been "selected to receive a retirement payment." We are not familiar with any studies that have viewed this type of alternative wording; however, we are interested to observe if the word "retirement" induces individuals to alter their discounting behavior.

D. CONVEX TIME BUDGET TREATMENT

Our CTB experiment is a replication of Andreoni and Sprenger (2010). This experimental setup provides individuals with 100 tokens. Individuals are asked to allocate those 100 tokens between a near term payment option, where each token has a value of a_t and a long-term payment option where each token has a value of $a_{(t+k)}$. For example, near term tokens have a value of \$0.10 and long term tokens have a value of \$0.12. An individual who splits 100 tokens evenly between the two options would receive \$5 in the near term and \$6 at a later term.

In accordance with Andreoni and Sprenger (2010), we present subjects with 45 convex budget decisions. The 45 different decisions presented result from variations in time for the initial payment (t), delay period (k), and interest rates applied to payments. Also in accordance with Andreoni and Sprenger (2010), we utilize the following parameters; near term payment dates of t = (0, 7, 35) and long term payment dates of k = (35, 70, 98). Interest rates are set to vary from 0 to over 1000 percent per year.

As with the MPL experiment, we use two payment schemes. The first duplicates Andreoni and Sprenger (2010) in which payments range from \$20–\$30. The second scheme presents subjects with choices that range from \$67,000 to \$340,000.

Because of the coin allocation mechanism in the CTB design, we are able to overcome higher than expected discount rate biases associated with the assumption of linear utility present in the MPL design. If utility is actually concave, a model such as

MPL that assumes linear utility will bias discount rates upwards (Andreoni & Sprenger, 2010). Additionally, the CTB methodology provides subjects with more choices and customizations. This approach agrees with Frederick et al., who in their thorough review of intertemporal choice studies provide a final view that "intertemporal choices reflect many distinct considerations and often involve the interplay of several competing motives" (2002, p. 394).

E. COMPENSATION OF SUBJECTS

In these experiments, we link individual responses to compensation to ensure that subjects' choices most accurately reflect their preferences. Prior to beginning the experiment, subjects are provided with verbal instructions which include a clear explanation of the monetary payments.

We inform subjects that they will receive compensation based on their answers to the experimental questions. One question will be selected at random in each subject group, and individuals will receive compensation based on their answer, or preferences displayed, to that question. Secondly, we explain to subjects that some questions deal with relatively small sums of money and other questions deal with relatively large sums of money. If a question dealing with a relatively small sum of money (under $20) is selected, subjects will receive payments that align exactly with their responses. If a question that deals with relatively large sums of money is selected, subjects will receive payments based on their selections that have been scaled down to a maximum payment of $30.

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V. REVIEW OF THE CNA ANALYSIS

In their analysis of military retirement reform, Grefer et al., (2012) review five potential options for military retirement reform. Additionally, they estimate a 20 percent reduction in military benefits, based on the Military Reform Act of 1986, and then spread those benefits across different time periods in order to develop the five options with different NPVs (Grefer et al.). For their analysis, officers are assigned discount rates ranging from 7.0–10.5 percent, while enlisted personnel are assigned discount rates ranging from 8.7–12.5 percent. These discount rates represent a service member with 10 YOS and are based on Grefer et al., (2012) literature review. Discount rates are kept static, and are then applied to benefits that span significantly different periods of time to calculate the change in career compensation.

Table 4. CNA Sample Discount Rates (From Grefer et al., 2012)

CNA scenario 1: Change in career compensation

Zone	Enlisted		Officer	
	Discount rate	Change in career compensation	Discount rate	Change in career compensation
A	8.7%	-2.6%	7.0%	-4.1%
B	8.7%	-4.3%	7.0%	-6.1%
C	8.7%	-6.6%	7.0%	-8.4%
D	8.7%	-10.2%	7.0%	-14.3%

There are five elements to the total compensation package. The defined benefits (DB2) and defined contribution (DC) portions of retirement are not available to service members until they reach the age of 62 and 60 respectively. The defined benefit (DB1) and continuation pay (CP) are not available until retirement at 20 YOS, while the transition pay (TP) becomes available earlier (12 YOS for enlisted personnel and16 YOS for officers).

Table 5. CNA Sample Retirement Structure (From Grefer et al., 2012)

Multipliers for components of OSD proposals, options A through D.1; Officers

	Option A	Option B	Option C	Option D	Option D.1
DB1	0.25*Hi-3	0.16*Hi-3	0.02*YOS *Hi-3	0.015*YOS *Hi-3	0.0175*YOS *Hi-3
DB2	0.025*YOS* Hi-3	0.02*YOS *Hi-3	0.02*YOS*Hi -3	0.015*YOS* Hi-3	0.0175*YOS *Hi-3
DC	0.05*BP	0.05*BP	0.05*BP	0.05*BP	0.05*BP
CP	5.78*(1-mo BP)	11.33*(1-mo BP)	8.69*(1-mo BP)	23.53*(1-mo BP)	16.13*(1-mo BP)
TP	2.5*(1-yr BP)	3.0*(1-yr BP)	0.5*(1-yr BP)	1.0*(1-yr BP)	0.75*(1-yr BP)

Each of these five benefits would become available to service members during significantly different time periods and represent significantly different types of compensation ranging from annuities to lump sum payments. Despite these variances, static discount rates are utilized across all of these potential benefits, ignoring the notion of time inconsistency in IDRs that has been captured by the body of intertemporal choice research (Frederick et al., 2002).

Research has shown higher IDR's for benefits to be received earlier and lower discount rates for benefits in more distant periods. The impact of varied discount rates, which comply with the observed behavior of time inconsistency, could significantly alter the projected NPVs of reformed benefits. It is possible that alternative NPVs could be higher for some scenarios; however, it is most likely that NPVs will be lower due to the impact of increased discount rates for earlier benefits reducing the value of those benefits. This potential reduction in NPVs could result in preferences amongst service members that differ from analysts' expectations.

Utilizing a NPV model created by Chu (2012), we are able to easily adjust discount rates amongst the five different types of compensation CNA models. We compare application of a static discount rate in officers of seven percent, as CNA does in its analyses (Grefer et al., 2012), with application of time inconsistent discount rates of seven percent applied to DB1, DB2, and DC and a marginally higher rate of 9.0 percent for CP and TP. This two percent increase is chosen to display potential changes in NPV due to a relatively small shift in discount rates. We then duplicate this process and

increase discount rates in the earlier payments by 10 percent to show the potential change in NPV with greater variance in IDRs. These variations provide discount rates that fall well within the range of discount rates measured in past research (Frederick et al., 2002). We then replicate this process for officers utilizing a static discount rate of 11 percent and for enlisted personnel with static discount rates of 8.7 and 12.5 percent in alignment with CNAs model.

Results of the modeling described above are shown in Tables 6 and 7. With application of discount rates that vary two percent between (TP, CP) and (DB1, DB2 and DC) we see a decrease in officer NPV ranging from 0.5 percent up to two percent across the five DoD options when compared to the NPV measured when discount rates are held constant at seven percent. When we apply this same treatment but with fixed discount rates set at 11 percent and again a two percent variation between (CP,TP) and (DB1, DB2, and DC) we find a decrease in NPV ranging from 0.7–2.7 percent. With higher variation in the IDR between (CP, TP) and (DB1, DB2, and DC) set to 10 percent, we see reductions in officer NPV of benefits ranging from 2.7 percent to 10.1 percent when compared to a static discount rate of seven percent; and decreases in NPV ranging from 3.9 percent to 13.2 percent when compared to a static discount rate of 11 percent. Results in enlisted personnel are similar, with discounts in NPV ranging from 0.7 percent up to 17.2 percent across all the options.

Table 6. Simulation of Multiple Discount Rates on Enlisted Personnel NPV

Table 6

Enlisted CNA Scenario 1 Discount Rate of 8.7% with 2% Variation

	Option A	Option B	Option C	Option D	Option D.1	Discount Rates
DB1	$139,958.34	$ 89,573.34	$223,933.34	$167,950.01	$195,941.67	8.7%
DB2	$ 41,437.41	$ 33,149.93	$ 33,149.93	$ 24,862.45	$ 29,006.19	8.7%
DC	$ 45,876.92	$ 45,876.92	$ 45,876.92	$ 45,876.92	$ 45,876.92	8.7%
CP	$ 19,298.99	$ 19,919.04	$ 19,919.04	$ 51,541.48	$ 35,885.27	10.7%
TP	$143,001.00	$171,601.20	$ 28,600.20	$ 57,200.40	$ 42,900.30	10.7%
NPV with variable d 8.7% and 10.7%	$389,572.66	$360,120.43	$351,479.43	$347,431.26	$349,610.36	
NPV with fixed d of 8.7%	$386,953.44	$357,417.05	$348,776.06	$340,436.14	$344,740.07	
Differnce in value	$ (2,619.22)	$ (2,703.38)	$ (2,703.38)	$ (6,995.11)	$ (4,870.28)	
% difference	0.7%	0.8%	0.8%	2.0%	1.4%	

Enlisted CNA Scenario 2 Discount Rate of 12.5% with 2% Variation

	Option A	Option B	Option C	Option D	Option D.1	Discount Rates
DB1	$106,982.63	$ 68,468.88	$171,172.21	$128,379.16	$149,775.68	12.5%
DB2	$ 15,315.58	$ 12,252.46	$ 12,252.46	$ 9,189.35	$ 10,720.91	12.5%
DC	$ 21,542.14	$ 21,542.14	$ 21,542.14	$ 21,542.14	$ 21,542.14	12.5%
CP	$ 25,281.19	$ 26,093.44	$ 26,093.44	$ 67,518.04	$ 47,008.80	14.5%
TP	$143,001.00	$171,601.20	$ 28,600.20	$ 57,200.40	$ 42,900.30	14.5%
NPV with variable d 12.5% and 14.5%	$312,122.54	$299,958.12	$259,660.45	$283,829.08	$271,947.82	
NPV with fixed d of 12.5%	$308,798.39	$296,527.17	$256,229.50	$274,951.33	$265,766.77	
NPV difference in value	$ (3,324.15)	$ (3,430.95)	$ (3,430.95)	$ (8,877.75)	$ (6,181.05)	
NPV% difference	1.1%	1.1%	1.3%	3.1%	2.3%	

Enlisted CNA Scenario 1 Discount Rate of 8.7% with 10% Variation

	Option A	Option B	Option C	Option D	Option D.1	Discount Rates
DB1	$139,958.34	$ 89,573.34	$223,933.34	$167,950.01	$195,941.67	8.7%
DB2	$ 41,437.41	$ 33,149.93	$ 33,149.93	$ 24,862.45	$ 29,006.19	8.7%
DC	$ 45,876.92	$ 45,876.92	$ 45,876.92	$ 45,876.92	$ 45,876.92	8.7%
CP	$ 33,725.57	$ 34,809.13	$ 34,809.13	$ 90,070.31	$ 62,710.61	18.7%
TP	$143,001.00	$171,601.20	$ 28,600.20	$ 57,200.40	$ 42,900.30	18.7%
NPV with variable d 8.7% and 18.7%	$403,999.25	$375,010.52	$366,369.52	$385,960.09	$376,435.69	
NPV with fixed d of 8.7%	$386,953.44	$357,417.05	$348,776.06	$340,436.14	$344,740.07	
NPV difference in value	$ (17,045.81)	$ (17,593.46)	$ (17,593.46)	$ (45,523.95)	$ (31,695.62)	
NPV% difference	4.2%	4.7%	4.8%	11.8%	8.4%	

Enlisted CNA Scenario 2 Discount Rate of 12.5% with 10% Variation

	Option A	Option B	Option C	Option D	Option D.1	Discount Rates
DB1	$106,982.63	$ 68,468.88	$171,172.21	$128,379.16	$149,775.68	12.5%
DB2	$ 15,315.58	$ 12,252.46	$ 12,252.46	$ 9,189.35	$ 10,720.91	12.5%
DC	$ 21,542.14	$ 21,542.14	$ 21,542.14	$ 21,542.14	$ 21,542.14	12.5%
CP	$ 43,395.26	$ 44,789.49	$ 44,789.49	$115,894.98	$ 80,690.79	22.5%
TP	$143,001.00	$171,601.20	$ 28,600.20	$ 57,200.40	$ 42,900.30	22.5%
NPV with variable d 12.5% and 22.5%	$330,236.61	$318,654.17	$278,356.50	$332,206.02	$305,629.81	
NPV with fixed d of 12.5%	$308,798.39	$296,527.17	$256,229.50	$274,951.33	$265,766.77	
NPV difference in value	$ (21,438.22)	$ (22,127.00)	$ (22,127.00)	$ (57,254.69)	$ (39,863.04)	
NPV% difference	6.5%	6.9%	7.9%	17.2%	13.0%	

Table 7. Simulation of Multiple Discount Rates on Officer NPV

Table 7

Officer CNA Scenario 1 Discount Rate of 7.0% with 2% Variation

	Option A	Option B	Option C	Option D	Option D.1	Discount Rates
DB1	$ 251,357.39	$ 160,868.73	$ 402,171.83	$ 301,628.87	$ 351,900.35	7.0%
DB2	$ 148,735.17	$ 118,988.13	$ 118,988.13	$ 89,241.10	$ 104,114.62	7.0%
DC	$ 125,700.60	$ 125,700.60	$ 125,700.60	$ 125,700.60	$ 125,700.60	7.0%
CP	$ 57,831.39	$ 113,361.54	$ 86,947.20	$ 235,427.81	$ 161,387.61	9.0%
TP	$ 245,979.00	$ 295,174.80	$ 49,195.80	$ 98,391.60	$ 73,793.70	9.0%
NPV with variable d 7.0% and 9.0%	$ 829,603.55	$ 814,093.80	$ 783,003.56	$ 850,389.97	$ 816,896.87	
NPV with fixed d of 7.0%	$ 825,474.44	$ 805,999.89	$ 776,795.61	$ 833,580.65	$ 805,373.95	
NPV difference in value	$ (4,129.11)	$ (8,093.91)	$ (6,207.95)	$ (16,809.32)	$ (11,522.92)	
NPV% difference	0.5%	1.0%	0.8%	2.0%	1.4%	

Officer CNA Scenario 2 Discount Rate of 11.0% with 2% Variation

	Option A	Option B	Option C	Option D	Option D.1	Discount Rates
DB1	$ 192,462.86	$ 123,176.23	$ 307,940.58	$ 230,955.43	$ 269,448.00	11.0%
DB2	$ 58,825.19	$ 47,060.15	$ 47,060.15	$ 35,295.11	$ 41,177.63	11.0%
DC	$ 68,079.31	$ 68,079.31	$ 68,079.31	$ 68,079.31	$ 68,079.31	11.0%
CP	$ 66,799.23	$ 130,940.36	$ 100,429.98	$ 271,935.27	$ 186,413.76	13.0%
TP	$ 245,979.00	$ 295,174.80	$ 49,195.80	$ 98,391.60	$ 73,793.70	13.0%
NPV with variable d 11.0% and 13.0%	$ 632,145.59	$ 664,430.85	$ 572,705.82	$ 704,656.72	$ 638,912.41	
NPV with fixed d of 11.0%	$ 627,540.51	$ 655,403.95	$ 565,782.28	$ 685,909.78	$ 626,061.23	
NPV difference in value	$ (4,605.07)	$ (9,026.90)	$ (6,923.54)	$ (18,746.94)	$ (12,851.18)	
NPV% difference	0.7%	1.4%	1.2%	2.7%	2.0%	

Officer CNA Scenario 1 Discount Rate of 7.0% with 10% Variation

	Option A	Option B	Option C	Option D	Option D.1	Discount Rates
DB1	$ 251,357.39	$ 160,868.73	$ 402,171.83	$ 301,628.87	$ 351,900.35	7.0%
DB2	$ 148,735.17	$ 118,988.13	$ 118,988.13	$ 89,241.10	$ 104,114.62	7.0%
DC	$ 125,700.60	$ 125,700.60	$ 125,700.60	$ 125,700.60	$ 125,700.60	7.0%
CP	$ 76,771.69	$ 150,488.46	$ 115,423.19	$ 312,532.52	$ 214,243.50	17.0%
TP	$ 245,979.00	$ 295,174.80	$ 49,195.80	$ 98,391.60	$ 73,793.70	17.0%
NPV with variable d 7.0% and 17.0%	$ 848,543.85	$ 851,220.72	$ 811,479.54	$ 927,494.68	$ 869,752.76	
NPV with fixed d of 7.0%	$ 825,474.44	$ 805,999.89	$ 776,795.61	$ 833,580.65	$ 805,373.95	
NPV difference in value	$ (23,069.41)	$ (45,220.83)	$ (34,683.93)	$ (93,914.04)	$ (64,378.81)	
NPV% difference	2.7%	5.3%	4.3%	10.1%	7.4%	

Officer CNA Scenario 2 Discount Rate of 11.0% with 10% Variation

	Option A	Option B	Option C	Option D	Option D.1	Discount Rates
DB1	$ 192,462.86	$ 123,176.23	$ 307,940.58	$ 230,955.43	$ 269,448.00	11.0%
DB2	$ 58,825.19	$ 47,060.15	$ 47,060.15	$ 35,295.11	$ 41,177.63	11.0%
DC	$ 68,079.31	$ 68,079.31	$ 68,079.31	$ 68,079.31	$ 68,079.31	11.0%
CP	$ 87,821.16	$ 172,147.70	$ 132,035.62	$ 357,514.16	$ 245,078.77	21.0%
TP	$ 245,979.00	$ 295,174.80	$ 49,195.80	$ 98,391.60	$ 73,793.70	21.0%
NPV with variable d 11.0% and 21.0%	$ 653,167.51	$ 705,638.19	$ 604,311.45	$ 790,235.61	$ 697,577.41	
NPV with fixed d of 11.0%	$ 627,540.51	$ 655,403.95	$ 565,782.28	$ 685,909.78	$ 626,061.23	
NPV difference in value	$ (25,627.00)	$ (50,234.24)	$ (38,529.17)	$ (104,325.83)	$ (71,516.18)	
NPV% difference	3.9%	7.1%	6.4%	13.2%	10.3%	

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VI. FINDINGS AND RECOMMENDATIONS

Significant variances in IDRs have been measured across a wide body of research, utilizing numerous different techniques ranging from observing actual transactions to purposing designed experiments. IDRs play a significant role in models used to calculate NPVs; thus it is import for policymakers and analysts to have access to the most accurate and appropriate IDRs. Warner and Pleeter (2001) show that a miscalculation of discount rates by DoD during the military drawdown of the early 1990s resulted in savings of greater than 1.7 billion dollars in separation payments. In this instance, DoD found itself on the positive side of error; however, it is possible that a similar error could instead cost DoD significantly. Such costs would not likely be direct but would instead be incurred through significant retention or recruiting changes.

The majority of research shows evidence of relatively high IDRs (Frederick et al., 2002), which aligns with proposals to reform military retirement by reducing the value of certain benefits and moving those benefits forward in time. Despite the rational belief that individuals will discount near prevailing interest rates, research has consistently shown otherwise (Frederick et al., 2002). The success of both credit card companies and payday loan stores, commonly located outside the main gates of military installations, provide clear evidence of individuals displaying high IDRs. However, convincing, we must make every effort to study these observations with sufficient attention towards known biases. An IDR preference for current disposable income likely will not have the same value as an IDR towards a longer-term retirement annuity.

This vast body of research supports the alterations to military retirement compensation proposed by DoD and analyzed in the CNA study. However, a significant portion of this research utilizes the unidimensional DU methodology, which distills numerous intertemporal choices into a single number using a single time and value-independent discount rate. As research on intertemporal choice has progressed, it is clear that IDRs are very situation specific (Frederick et al., 2001), making the results of past studies valuable but not necessarily suitable. An alternative would emphasize more focused research using time-dependent IDRs.

Changes to military retirement, should they be implemented, will undoubtedly have a significant impact on the behaviors of current and future service members. The CBO (2012a, p. 1) states that changes to the current retirement system "could cost less or more than the current system, depending on how they were structured and implemented, and savings might not be achieved for several years." Given the narrow margins for error that DoD must traverse regarding costs and unexpected changes in retention and recruiting, every effort should be made to mitigate potentially costly and dangerous risks inherent with an overly simplistic analysis of this retirement compensation reform.

To ensure the most accurate retirement analysis is provided to policymakers, DoD and DON should conduct further research on service member discount rates, providing specific attention to time inconsistencies and demographic trends in discounting behavior. Grefer et al., (2012) find that changes to military retirement described in the CNA report will reduce retention and achieve savings largely from the resulting more junior force. Additionally, Grefer et al., (2012) estimate 51 years from when retirement reform is implemented until the retirement pension debt is paid down, if DoD grandfathers all current service members. Given these potentially significant shifts in the military manpower footprint for such modest changes in the military retirement system's debt burden, care should be taken to fully evaluate the potential impacts of military retirement reform.

APPENDIX A. INSTRUCTION TO PARTICIPANT

Payment for your Participation

You will receive a $10 participation payment for this experiment. You will receive this $10 participation payment in two $5 payments which will be provided at some earlier and later date. The dates of the payment will be based on your answers to a randomly selected question in the experiment.

Additionally, in this experiment you will be asked to make choices about allocating money between two points in time, one time is earlier and one time is later. One of these questions will be randomly selected, and you will receive an additional payment in excess of the $10 participation payment based on your answer to the randomly selected question. Some questions deal with very large amounts of money and some questions deal with small amounts of money. In the case of questions with small amounts of money, you will receive payments that are equal to your allocations or selections. In the case of questions with large amounts of money, you will receive payments that are scaled down.

Your Identity

In order to receive payment, we will need to collect the following personal identity information from you: name, e-mail address, mailing address, and phone number. This information will only be seen by Professor Myung and his research assistant. After all payments have been sent, this information will be destroyed. Your identity will not be a part of subsequent data analysis.

You have been assigned a participant number. This number will be linked to your personal information in order to provide you payment based on your responses. After all payments have been made, only the participant number will remain in the data set and as stated earlier, your personal information will be destroyed.

The Study

In this study you will be asked one of two types of questions about receiving money at either an earlier or later date. In one type of question you will be asked to select between receiving some dollar amount at an earlier date or receiving some alternative

larger dollar amount at a later date. In the second type of question you will be provided 100 tokens and asked to allocate those tokens to an earlier or later date. Tokens allocated to the earlier date will have lower values than tokens allocated to the later date. For example a token received today might be worth 10 cents/token and a token received next week might be worth 12 cents/token.

These two types of questions are best described by the following example questions.

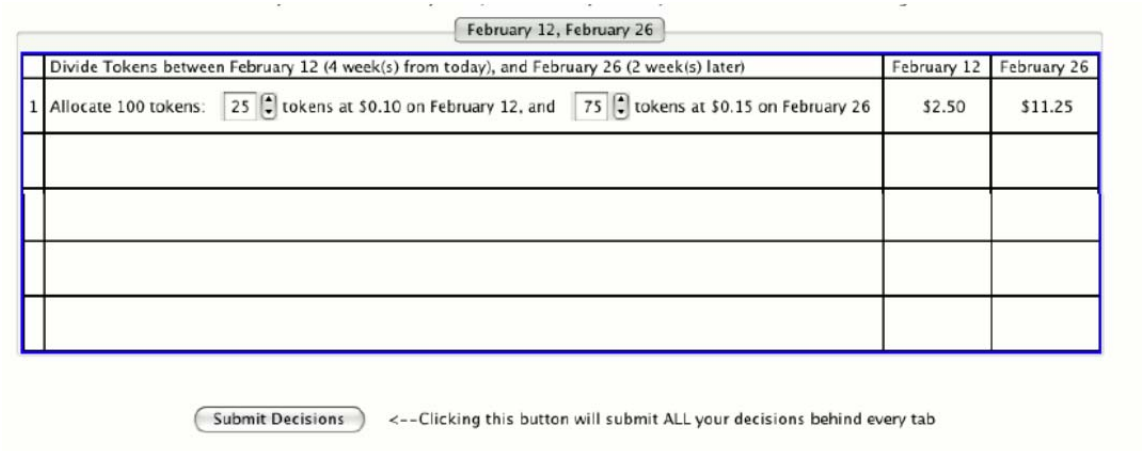
Sample MPL Question

Imagine that you have been selected to receive a cash payment. You may either receive payment option A in one month or payment option B in seven months. Please select your preferred payment option (A or B) for the following payoff alternatives.

	PAYMENT OPTION A (Pays A in 4 weeks)	PAYMENT OPTION B (Pays B in 6 weeks)
Select Option (A) or (B)	$20.00	20.25
Select Option (A) or (B)	$20.00	20.50
Select Option (A) or (B)	$20.00	20.75
Select Option (A) or (B)	$20.00	21.00
Select Option (A) or (B)	$20.00	21.25
Select Option (A) or (B)	$20.00	22.50
Select Option (A) or (B)	***Continued to 30 options***	***Continued to 30 options***

Sample CTB Question

Imagine that you have been selected to receive a cash payment in the form of 100 tokens. You may allocate the tokens between two points in time, an "earlier payment" and "later payment." Tokens may have different value at the two different points in time.



APPENDIX B. INSTRUCTION TO PARTICIPANT

Consent to Participate

***1. 1. This experiment is for active duty United States military personnel only. By participating in this experiment you are acknowledging that you are an active duty service member in the United States military.**

I. Introduction: You are invited to participate in an experiment entitled, "Eliciting Personal Discount Rates in Active Duty Service Members". The purpose of this research is designed to better determine military service member discounting preferences, and determine how those preferences might impact service member behavior with changes to the military retirement system. Analysis of this experiment will assist Naval Post Graduate School (NPS) researchers and student thesis work.

II. Background Information: The Naval Postgraduate School, Graduate School of Business and Public Policy (GSBPP), is conducting this experiment.

III. Procedures: The experiment consists of 30 questions and takes approximately 20 minutes to complete. The experiment contains questions regarding personnel financial decisions and questions regarding demographics. For each question, click on the appropriate answer and then click NEXT to advance to the next screen. All questions must be answered for the experiment to be submitted correctly.

IV. Risks and Benefits: I understand that this research involves no risks or discomforts greater than those encountered in the use of a computer. I understand that my participation in this experiment will provide data for the researcher to analyze active duty service member's discounting preferences, and their impact on current military retirement system and proposed changes. I understand that there is a minor risk of breach of confidentiality and that I will not directly benefit from the research.

V. Compensation: I understand that I will receive a minimum of $5.00 for my participation in this experiment, payable upon completion of the experiment. I understand that a limited number of individuals completing the experiment will be selected at random to receive a large sum of money. Selection and payment amount will be randomly selected.

VI. Confidentiality and Privacy Act: I understand the records of this study will be kept confidential. No information will be publicly accessible which could identify me as a participant. I understand that records of my participation will be retained permanently at NPS.

VII. Voluntary Nature of the Study: I understand that my participation is strictly voluntary. If I agree to participate, I am free to withdraw from the study at any time without prejudice. I may print out a copy of this screen for my records.

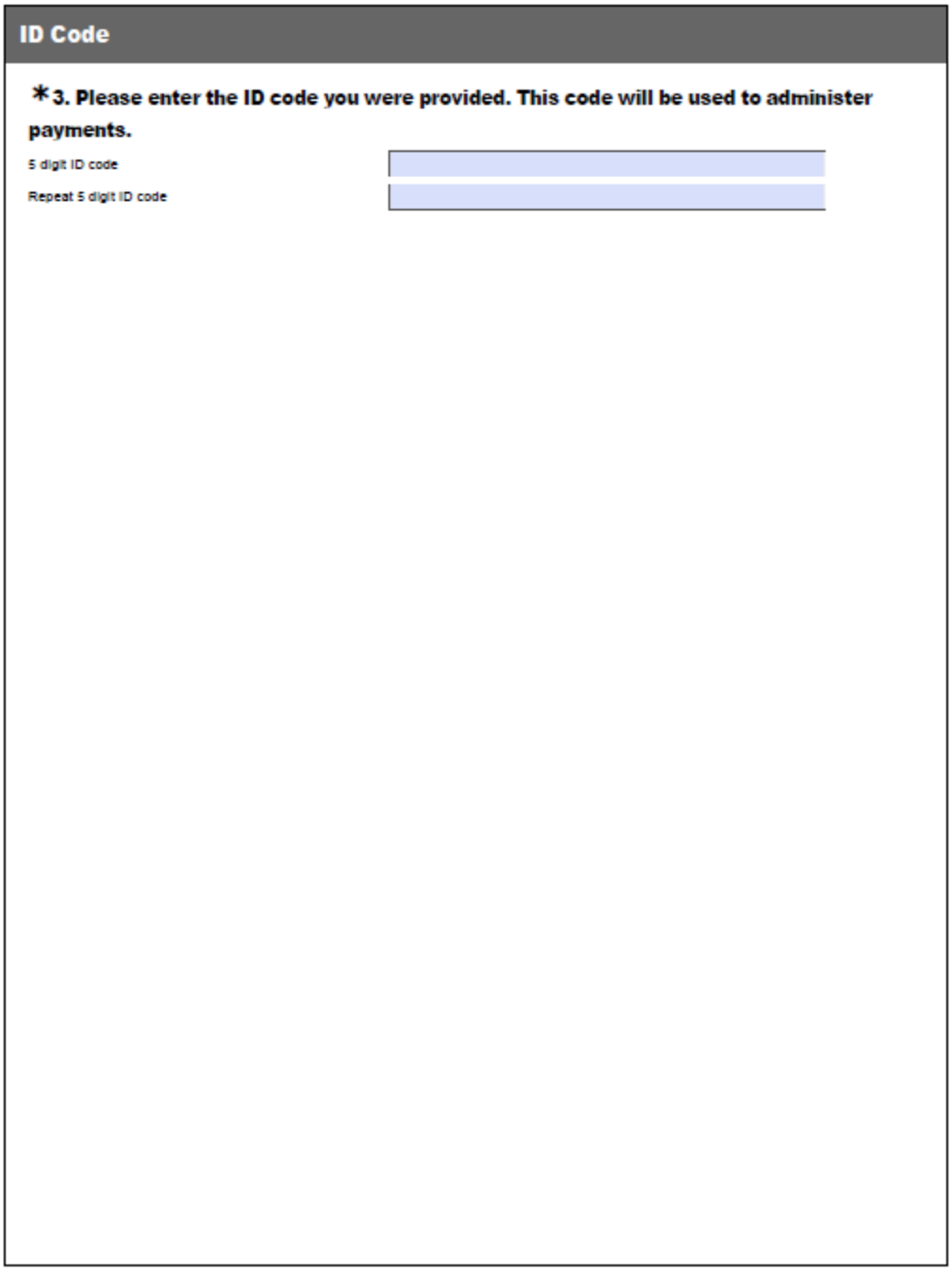
VIII. Point of Contact: I understand that if I experience any injury or discomfort from participating in the research or if I have any further questions or comments after the completion of the study I may contact the Principal Investigator, Dr. Noah Myung at nmyung@nps.edu.

IX. Statement of Consent: By clicking the YES button below I am acknowledging that I have read and understand this information and agree to voluntarily participate in this experiment. I also understand that I may stop at any time by exiting this website.

- Yes
- No

***2. 2. The researchers are authorized to quote my responses verbatim in their final report. Reminder, all responses are anonymous.**

- Yes
- No


ID Code
*3. Please enter the ID code you were provided. This code will be used to administer payments.
5 digit ID code
Repeat 5 digit ID code

***4. What is your best estimation of the annual interest rates charged by credit card companies?**

5.0%	12.0%	19.0%
6.0%	13.0%	20.0%
7.0%	14.0%	21.0%
8.0%	15.0%	22.0%
9.0%	16.0%	23.0%
10.0%	17.0%	24.0%
11.0%	18.0%	25.0%

5. What is your best estimation of the current interest rate for a home mortgage?

- 1.0%
- 1.5%
- 2.0%
- 2.5%
- 3.0%
- 3.5%
- 4.0%
- 4.5%
- 5.0%
- 5.5%
- 6.0%
- 6.5%
- 7.0%
- 8.0%

***6. What is your best estimation of the current interest rate you could recieve on money placed in a savings account? (Stated otherwise, what is the the current savings rate being offered by banks?)**

- Less than 1%
- 1%-2%
- 2%-3%
- 3%-4%
- Greater than 5%

***7. Please select the last digit of your mobile phone or home phone number.**

- 0
- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9

Personal Discount Rate Question (Group A.1)

***8. Imagine that you have been selected to receive a cash payment. You may either receive payment option A in one month or payment option B in seven months. Please select your preferred payment option (A or B) for the following 20 payoff alternatives.**

	PAYMENT OPTION A (Pays A in 1 month)	PAYMENT OPTION B (Pays B in 7 months)
1. (A) $67,000.00 or (B) $67,837.50	○	○
2. (A) $67,000.00 or (B) $68,675.00	○	○
3. (A) $67,000.00 or (B) $69,512.50	○	○
4. (A) $67,000.00 or (B) $70,350.00	○	○
5. (A) $67,000.00 or (B) $71,187.50	○	○
6. (A) $67,000.00 or (B) $72,025.00	○	○
7. (A) $67,000.00 or (B) $72,862.50	○	○
8. (A) $67,000.00 or (B) $73,700.00	○	○
9. (A) $67,000.00 or (B) $74,537.50	○	○
10. (A) $67,000.00 or (B) $75,375.00	○	○
11. (A) $67,000.00 or (B) $76,212.50	○	○
12. (A) $67,000.00 or (B) $77,050.00	○	○
13. (A) $67,000.00 or (B) $77,887.50	○	○
14. (A) $67,000.00 or (B) $78,725.00	○	○
15. (A) $67,000.00 or (B) $79,562.50	○	○
16. (A) $67,000.00 or (B) $80,400.00	○	○
17. (A) $67,000.00 or (B) $81,237.50	○	○
18. (A) $67,000.00 or (B) $82,075.00	○	○
19. (A) $67,000.00 or (B) $82,912.50	○	○
20. (A) $67,000.00 or (B) $83,750.00	○	○

Personal Discount Rate Question (Group A.2)

***9. Imagine that you have been selected to receive a cash payment. You may either receive payment option A in one month or payment option B in thirteen months. Please select your preferred payment option (A or B) for the following 20 payoff alternatives.**

	PAYMENT OPTION A (Pays A in 1 month)	PAYMENT OPTION B (Pays B in 13 months)
1. (A) $67,000.00 or (B) $68,675.00	○	○
2. (A) $67,000.00 or (B) $70,350.00	○	○
3. (A) $67,000.00 or (B) $72,025.00	○	○
4. (A) $67,000.00 or (B) $73,700.00	○	○
5. (A) $67,000.00 or (B) $75,375.00	○	○
6. (A) $67,000.00 or (B) $77,050.00	○	○
7. (A) $67,000.00 or (B) $78,725.00	○	○
8. (A) $67,000.00 or (B) $80,400.00	○	○
9. (A) $67,000.00 or (B) $82,075.00	○	○
10. (A) $67,000.00 or (B) $83,750.00	○	○
11. (A) $67,000.00 or (B) $85,425.00	○	○
12. (A) $67,000.00 or (B) $87,100.00	○	○
13. (A) $67,000.00 or (B) $88,775.00	○	○
14. (A) $67,000.00 or (B) $90,450.00	○	○
15. (A) $67,000.00 or (B) $92,125.00	○	○
16. (A) $67,000.00 or (B) $93,800.00	○	○
17. (A) $67,000.00 or (B) $95,475.00	○	○
18. (A) $67,000.00 or (B) $97,150.00	○	○
19. (A) $67,000.00 or (B) $98,825.00	○	○
20. (A) $67,000.00 or (B) $100,500.00	○	○

Personal Discount Rate Question (Group A.3)

***10. Imagine that you have been selected to receive a cash payment. You may either receive payment option A in one month or payment option B in twenty-five months. Please select your preferred payment option (A or B) for the following 20 payoff alternatives.**

	PAYMENT OPTION A (Pays A in 1 month)	PAYMENT OPTION B (Pays B in 25 months)
1. (A) $67,000.00 or (B) $70,391.88		
2. (A) $67,000.00 or (B) $73,867.50		
3. (A) $67,000.00 or (B) $77,426.88		
4. (A) $67,000.00 or (B) $81,070.00		
5. (A) $67,000.00 or (B) $84,796.88		
6. (A) $67,000.00 or (B) $88,607.50		
7. (A) $67,000.00 or (B) $92,501.88		
8. (A) $67,000.00 or (B) $96,480.00		
9. (A) $67,000.00 or (B) $100,541.88		
10. (A) $67,000.00 or (B) $104,687.50		
11. (A) $67,000.00 or (B) $108,916.88		
12. (A) $67,000.00 or (B) $113,230.00		
13. (A) $67,000.00 or (B) $117,626.88		
14. (A) $67,000.00 or (B) $122,107.50		
15. (A) $67,000.00 or (B) $126,671.88		
16. (A) $67,000.00 or (B) $131,320.00		
17. (A) $67,000.00 or (B) $136,051.88		
18. (A) $67,000.00 or (B) $140,867.50		
19. (A) $67,000.00 or (B) $145,766.88		
20. (A) $67,000.00 or (B) $150,750.00		

Personal Discount Rate Question (Group A.4)

***11. Imagine that you have been selected to receive a cash payment. You may either receive payment option A in one month or payment option B in forty-nine months. Please select your preferred payment option (A or B) for the following 20 payoff alternatives.**

	PAYMENT OPTION A (Pays A in 1 month)	PAYMENT OPTION B (Pays B in 49 months)
1. (A) $67,000.00 or (B) $73,955.46	○	○
2. (A) $67,000.00 or (B) $81,438.92	○	○
3. (A) $67,000.00 or (B) $89,476.43	○	○
4. (A) $67,000.00 or (B) $98,094.70	○	○
5. (A) $67,000.00 or (B) $107,321.04	○	○
6. (A) $67,000.00 or (B) $117,183.42	○	○
7. (A) $67,000.00 or (B) $127,710.40	○	○
8. (A) $67,000.00 or (B) $138,931.20	○	○
9. (A) $67,000.00 or (B) $150,875.65	○	○
10. (A) $67,000.00 or (B) $163,574.22	○	○
11. (A) $67,000.00 or (B) $177,057.99	○	○
12. (A) $67,000.00 or (B) $191,358.70	○	○
13. (A) $67,000.00 or (B) $206,508.68	○	○
14. (A) $67,000.00 or (B) $222,540.92	○	○
15. (A) $67,000.00 or (B) $239,489.01	○	○
16. (A) $67,000.00 or (B) $257,387.20	○	○
17. (A) $67,000.00 or (B) $276,270.34	○	○
18. (A) $67,000.00 or (B) $296,173.92	○	○
19. (A) $67,000.00 or (B) $317,134.06	○	○
20. (A) $67,000.00 or (B) $339,187.50	○	○

Personal Discount Rate Question (Group A.5)

***12. Imagine that you have been selected to receive a cash payment. You may either receive payment option A in five years or payment option B in five years and six months. Please select your preferred payment option (A or B) for the following 20 payoff alternatives.**

	PAYMENT OPTION A (Pays A in 5 years)	PAYMENT OPTION B (Pays B in 5 years and 6 months)
1. (A) $67,000.00 or (B) $67,837.50	○	○
2. (A) $67,000.00 or (B) $68,675.00	○	○
3. (A) $67,000.00 or (B) $69,512.50	○	○
4. (A) $67,000.00 or (B) $70,350.00	○	○
5. (A) $67,000.00 or (B) $71,187.50	○	○
6. (A) $67,000.00 or (B) $72,025.00	○	○
7. (A) $67,000.00 or (B) $72,862.50	○	○
8. (A) $67,000.00 or (B) $73,700.00	○	○
9. (A) $67,000.00 or (B) $74,537.50	○	○
10. (A) $67,000.00 or (B) $75,375.00	○	○
11. (A) $67,000.00 or (B) $76,212.50	○	○
12. (A) $67,000.00 or (B) $77,050.00	○	○
13. (A) $67,000.00 or (B) $77,887.50	○	○
14. (A) $67,000.00 or (B) $78,725.00	○	○
15. (A) $67,000.00 or (B) $79,562.50	○	○
16. (A) $67,000.00 or (B) $80,400.00	○	○
17. (A) $67,000.00 or (B) $81,237.50	○	○
18. (A) $67,000.00 or (B) $82,075.00	○	○
19. (A) $67,000.00 or (B) $82,912.50	○	○
20. (A) $67,000.00 or (B) $83,750.00	○	○

Personal Discount Rate Question (Group A.6)

***13. Imagine that you have been selected to receive a cash payment. You may either receive payment option A in ten years or payment option B in ten years and six months. Please select your preferred payment option (A or B) for the following 20 payoff alternatives.**

	PAYMENT OPTION A (Pays A in 10 years)	PAYMENT OPTION B (Pays B in 10 years and 6 months)
1. (A) $67,000.00 or (B) $67,837.50	○	○
2. (A) $67,000.00 or (B) $68,675.00	○	○
3. (A) $67,000.00 or (B) $69,512.50	○	○
4. (A) $67,000.00 or (B) $70,350.00	○	○
5. (A) $67,000.00 or (B) $71,187.50	○	○
6. (A) $67,000.00 or (B) $72,025.00	○	○
7. (A) $67,000.00 or (B) $72,862.50	○	○
8. (A) $67,000.00 or (B) $73,700.00	○	○
9. (A) $67,000.00 or (B) $74,537.50	○	○
10. (A) $67,000.00 or (B) $75,375.00	○	○
11. (A) $67,000.00 or (B) $76,212.50	○	○
12. (A) $67,000.00 or (B) $77,050.00	○	○
13. (A) $67,000.00 or (B) $77,887.50	○	○
14. (A) $67,000.00 or (B) $78,725.00	○	○
15. (A) $67,000.00 or (B) $79,562.50	○	○
16. (A) $67,000.00 or (B) $80,400.00	○	○
17. (A) $67,000.00 or (B) $81,237.50	○	○
18. (A) $67,000.00 or (B) $82,075.00	○	○
19. (A) $67,000.00 or (B) $82,912.50	○	○
20. (A) $67,000.00 or (B) $83,750.00	○	○

Personal Discount Rate Question (Group B.1)

***14. Imagine that you have been selected to receive a retirement payment. You may either receive payment option A in one month or payment option B in seven months. Please select your preferred payment option (A or B) for the following 20 retirement payoff alternatives.**

	PAYMENT OPTION A (Pays A in 1 month)	PAYMENT OPTION B (Pays B in 7 months)
1. (A) $67,000.00 or (B) $67,837.50	○	○
2. (A) $67,000.00 or (B) $68,675.00	○	○
3. (A) $67,000.00 or (B) $69,512.50	○	○
4. (A) $67,000.00 or (B) $70,350.00	○	○
5. (A) $67,000.00 or (B) $71,187.50	○	○
6. (A) $67,000.00 or (B) $72,025.00	○	○
7. (A) $67,000.00 or (B) $72,862.50	○	○
8. (A) $67,000.00 or (B) $73,700.00	○	○
9. (A) $67,000.00 or (B) $74,537.50	○	○
10. (A) $67,000.00 or (B) $75,375.00	○	○
11. (A) $67,000.00 or (B) $76,212.50	○	○
12. (A) $67,000.00 or (B) $77,050.00	○	○
13. (A) $67,000.00 or (B) $77,887.50	○	○
14. (A) $67,000.00 or (B) $78,725.00	○	○
15. (A) $67,000.00 or (B) $79,562.50	○	○
16. (A) $67,000.00 or (B) $80,400.00	○	○
17. (A) $67,000.00 or (B) $81,237.50	○	○
18. (A) $67,000.00 or (B) $82,075.00	○	○
19. (A) $67,000.00 or (B) $82,912.50	○	○
20. (A) $67,000.00 or (B) $83,750.00	○	○

Personal Discount Rate Question (Group B.2)

***15. Imagine that you have been selected to receive a retirement payment. You may either receive payment option A in one month or payment option B in thirteen months. Please select your preferred payment option (A or B) for the following 20 retirment payoff alternatives.**

	PAYMENT OPTION A (Pays A in 1 month)	PAYMENT OPTION B (Pays B in 13 months)
1. (A) $67,000.00 or (B) $68,675.00	○	○
2. (A) $67,000.00 or (B) $70,350.00	○	○
3. (A) $67,000.00 or (B) $72,025.00	○	○
4. (A) $67,000.00 or (B) $73,700.00	○	○
5. (A) $67,000.00 or (B) $75,375.00	○	○
6. (A) $67,000.00 or (B) $77,050.00	○	○
7. (A) $67,000.00 or (B) $78,725.00	○	○
8. (A) $67,000.00 or (B) $80,400.00	○	○
9. (A) $67,000.00 or (B) $82,075.00	○	○
10. (A) $67,000.00 or (B) $83,750.00	○	○
11. (A) $67,000.00 or (B) $85,425.00	○	○
12. (A) $67,000.00 or (B) $87,100.00	○	○
13. (A) $67,000.00 or (B) $88,775.00	○	○
14. (A) $67,000.00 or (B) $90,450.00	○	○
15. (A) $67,000.00 or (B) $92,125.00	○	○
16. (A) $67,000.00 or (B) $93,800.00	○	○
17. (A) $67,000.00 or (B) $95,475.00	○	○
18. (A) $67,000.00 or (B) $97,150.00	○	○
19. (A) $67,000.00 or (B) $98,825.00	○	○
20. (A) $67,000.00 or (B) $100,500.00	○	○

Personal Discount Rate Question (Group B.3)

***16. Imagine that you have been selected to receive a retirement payment. You may either receive payment option A in one month or payment option B in twenty-five months. Please select your preferred payment option (A or B) for the following 20 retirment payoff alternatives.**

	PAYMENT OPTION A (Pays A in 1 month)	PAYMENT OPTION B (Pays B in 25 months)
1. (A) $67,000.00 or (B) $70,391.88		
2. (A) $67,000.00 or (B) $73,867.50		
3. (A) $67,000.00 or (B) $77,426.88		
4. (A) $67,000.00 or (B) $81,070.00		
5. (A) $67,000.00 or (B) $84,796.88		
6. (A) $67,000.00 or (B) $88,607.50		
7. (A) $67,000.00 or (B) $92,501.88		
8. (A) $67,000.00 or (B) $96,480.00		
9. (A) $67,000.00 or (B) $100,541.88		
10. (A) $67,000.00 or (B) $104,687.50		
11. (A) $67,000.00 or (B) $108,916.88		
12. (A) $67,000.00 or (B) $113,230.00		
13. (A) $67,000.00 or (B) $117,626.88		
14. (A) $67,000.00 or (B) $122,107.50		
15. (A) $67,000.00 or (B) $126,671.88		
16. (A) $67,000.00 or (B) $131,320.00		
17. (A) $67,000.00 or (B) $136,051.88		
18. (A) $67,000.00 or (B) $140,867.50		
19. (A) $67,000.00 or (B) $145,766.88		
20. (A) $67,000.00 or (B) $150,750.00		

Personal Discount Rate Question (Group B.4)

***17. Imagine that you have been selected to receive a retirement payment. You may either receive payment option A in one month or payment option B in forty-nine months. Please select your preferred payment option (A or B) for the following 20 retirement payoff alternatives.**

	PAYMENT OPTION A (Pays A in 1 month)	PAYMENT OPTION B (Pays B in 49 months)
1. (A) $67,000.00 or (B) $73,955.46	○	○
2. (A) $67,000.00 or (B) $81,438.92	○	○
3. (A) $67,000.00 or (B) $89,476.43	○	○
4. (A) $67,000.00 or (B) $98,094.70	○	○
5. (A) $67,000.00 or (B) $107,321.04	○	○
6. (A) $67,000.00 or (B) $117,183.42	○	○
7. (A) $67,000.00 or (B) $127,710.40	○	○
8. (A) $67,000.00 or (B) $138,931.20	○	○
9. (A) $67,000.00 or (B) $150,875.65	○	○
10. (A) $67,000.00 or (B) $163,574.22	○	○
11. (A) $67,000.00 or (B) $177,057.99	○	○
12. (A) $67,000.00 or (B) $191,358.70	○	○
13. (A) $67,000.00 or (B) $206,508.68	○	○
14. (A) $67,000.00 or (B) $222,540.92	○	○
15. (A) $67,000.00 or (B) $239,489.01	○	○
16. (A) $67,000.00 or (B) $257,387.20	○	○
17. (A) $67,000.00 or (B) $276,270.34	○	○
18. (A) $67,000.00 or (B) $296,173.92	○	○
19. (A) $67,000.00 or (B) $317,134.06	○	○
20. (A) $67,000.00 or (B) $339,187.50	○	○

Personal Discount Rate Question (Group B.5)

***18. Imagine that you have been selected to receive a retirement payment. You may either receive payment option A in five years or payment option B in five years and six months. Please select your preferred payment option (A or B) for the following 20 retirement payoff alternatives.**

	PAYMENT OPTION A (Pays A in 5 years)	PAYMENT OPTION B (Pays B in 5 years and 6 months)
1. (A) $67,000.00 or (B) $67,837.50	○	○
2. (A) $67,000.00 or (B) $68,675.00	○	○
3. (A) $67,000.00 or (B) $69,512.50	○	○
4. (A) $67,000.00 or (B) $70,350.00	○	○
5. (A) $67,000.00 or (B) $71,187.50	○	○
6. (A) $67,000.00 or (B) $72,025.00	○	○
7. (A) $67,000.00 or (B) $72,862.50	○	○
8. (A) $67,000.00 or (B) $73,700.00	○	○
9. (A) $67,000.00 or (B) $74,537.50	○	○
10. (A) $67,000.00 or (B) $75,375.00	○	○
11. (A) $67,000.00 or (B) $76,212.50	○	○
12. (A) $67,000.00 or (B) $77,050.00	○	○
13. (A) $67,000.00 or (B) $77,887.50	○	○
14. (A) $67,000.00 or (B) $78,725.00	○	○
15. (A) $67,000.00 or (B) $79,562.50	○	○
16. (A) $67,000.00 or (B) $80,400.00	○	○
17. (A) $67,000.00 or (B) $81,237.50	○	○
18. (A) $67,000.00 or (B) $82,075.00	○	○
19. (A) $67,000.00 or (B) $82,912.50	○	○
20. (A) $67,000.00 or (B) $83,750.00	○	○

Personal Discount Rate Question (Group B.6)

***19. Imagine that you have been selected to receive a retirement payment. You may either receive payment option A in ten years or payment option B in ten years and six months. Please select your preferred payment option (A or B) for the following 20 retirement payoff alternatives.**

	PAYMENT OPTION A (Pays A in 10 years)	PAYMENT OPTION B (Pays B in 10 years and 6 months)
1. (A) $67,000.00 or (B) $67,837.50	○	○
2. (A) $67,000.00 or (B) $68,675.00	○	○
3. (A) $67,000.00 or (B) $69,512.50	○	○
4. (A) $67,000.00 or (B) $70,350.00	○	○
5. (A) $67,000.00 or (B) $71,187.50	○	○
6. (A) $67,000.00 or (B) $72,025.00	○	○
7. (A) $67,000.00 or (B) $72,862.50	○	○
8. (A) $67,000.00 or (B) $73,700.00	○	○
9. (A) $67,000.00 or (B) $74,537.50	○	○
10. (A) $67,000.00 or (B) $75,375.00	○	○
11. (A) $67,000.00 or (B) $76,212.50	○	○
12. (A) $67,000.00 or (B) $77,050.00	○	○
13. (A) $67,000.00 or (B) $77,887.50	○	○
14. (A) $67,000.00 or (B) $78,725.00	○	○
15. (A) $67,000.00 or (B) $79,562.50	○	○
16. (A) $67,000.00 or (B) $80,400.00	○	○
17. (A) $67,000.00 or (B) $81,237.50	○	○
18. (A) $67,000.00 or (B) $82,075.00	○	○
19. (A) $67,000.00 or (B) $82,912.50	○	○
20. (A) $67,000.00 or (B) $83,750.00	○	○

General Military Demographic Information

*20. What is your branch of service?

*21. What is your rank?

*22. What is your specialty (i.e. USMC MOS 4 digit code; USN NEC 2 letter, 1 number code; Army MOS 2 number, 1 letter code; Air Force AFSC 5 digit alphanumeric code)?

*23. How many years of active duty military service do you have?

General Demographic Information

***24. What is your current age?**

***25. What is your gender?**

- Female
- Male

***26. Are you now married, widowed, divorced, separated, or never married?**

- Married
- Widowed
- Divorced
- Separated
- Never married

***27. How many dependents do you have, including a spouse?**

- 0
- 1
- 2
- 3
- 4 or more

***28. What is your ethnicity?**

- Hispanic or Latino
- Not Hispanic or Latino
- Decline to answer

***29. What is your race? Please mark one or more races to indicate what you consider yourself to be.**

- American Indian or Alaska Native
- Asian
- Black or African American
- Native Hawaiian or Other Pacific Islander
- White
- Other
- Decline to answer

***30. My current family income bracket is approximately?**

- Less than $20,000
- $20,000-$30,000
- $30,000-$50,000
- $50,000-$75,000
- $75,000-$100,000
- $100,000-$125,000
- $125,000-$150,000
- More than $150,000

***31. What is your highest level of educational attainment?**

- H.S. or GED
- Some College
- Associates Degree
- Undergraduate Degree
- Graduate Degree
- Doctorate
- Professional Degree

***32. What is (was) your field of study for your highest level of educational attainment?**

- Physical Sciences
- Life Sciences
- Social Sciences
- Arts and Humanities
- Engineering
- Business
- Other

***33. Have you ever taken any college courses in economics and/or finance?**

- Yes
- No

***34. Have you ever taken any college courses in economics and/or finance beyond introductory level courses?**

- Yes
- No

***35. With regards to personal financial, savings, and investing what do you consider yourself to be? (More conservative = higher savings/investment. More liberal = higher spending/consumption.)**

- Conservative
- Moderately Conservative
- Moderate
- Moderately Liberal
- Liberal

***36. With regards to personal finance, savings, and investing, what is your current level of knowledge and competence?**

- Minimally knowledgeable/competent
- Somewhat below knowledgeable/competent
- Knowledgeable/competent
- Somewhat above knowledgeable/competent
- Highly knowledgeable/competent

***37. Do you currently have credit card debt or do you typically carry credit card debt?**

- Yes
- No

***38. What do you estimate to be the interest rate charged by your Credit Card Company for carrying a debt balance?**

- 0%-5%
- 5%-10%
- 10%-15%
- 15%-20%
- 20%-25%
- Greater than 25%

***39. Do you currently have a home mortgage or have held a home mortgage in the past?**

- Yes
- No

General Retirement Information

***40. Do your currently contribute to Thrift Savings Plan (TSP) or an Individual Retirement Account (IRA) or have you in the past?**

- Yes
- No

***41. In terms of your personal priorities, how would you rank saving money for retirement?**

- Very important
- Somewhat important
- Neutral
- Somewhat unimportant
- Unimportant

***42. When you first joined the military, did you plan to stay until retirement?**

- Yes
- No
- I was undecided

***43. Have you achieved a high enough rank in which you can now reach 20 years of service and retire? (Typically E-6 or O-4)**

- Yes
- No

***44. Do you currently plan to stay in the military until you are eligible for retirement?**

- Yes
- No
- Undecided

***45. If you do plan to retire from the military, how many years do you expect to be alive following retirement?**

- I dont plan to retire from the military
- 70+ years
- 60+ years
- 50+ years
- 40+ years
- 30+ years
- 20+ years
- 10+ years

46. 30. Please comment on if or how the current military retirement system has impacted your decisions to save money for retirement.

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